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CUTTING YIELDS FROM STANDARD HARDWOOD LUMBER GRADES WHEN GANG R--ETC(U)
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United States
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**Forest
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Laboratory**

Research
Paper
FPL 370

September 1980

Cutting Yields from Standard Hardwood Lumber Grades when Gang Ripping

Abstract

This paper contains nomograms for the prediction of furniture clear cutting yields from standard NHLA lumber grades when the lumber is processed by gang ripping first. Complete instructions and examples are given for use of these nomograms. It is recommended that users first be familiar with the contents of "Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields?" Research Paper FPL 369.

Key Words: Furniture Cuttings, Hardwood Lumber, Rough Mill, Dimension Yields, Gang-rip, Lumber Cut-up.

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Research
Paper

FPL 370

Cutting Yields from Standard Hardwood Lumber Grades when Gang Ripping

By
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Introduction

This publication contains charts in nomogram form ~~(figs. 1a-5b)~~ that can be used to determine furniture cutting yields from hardwood lumber graded by standard National Hardwood Lumber Association (NHLA) grades[2] when that lumber is initially processed by gang ripping rather than by the more conventional crosscutting. The study in which the gang ripping yield data was developed is reported in USDA Forest Service Research Paper FPL 369.[3] It is suggested that the user of the nomograms in this publication be familiar with the contents of that publication. Prior research by Englerth and Schumann[4] developed nomograms for the prediction of clear cutting yields when standard-graded hardwood lumber is conventionally processed by crosscutting first.

The concept of gang ripping is based on the assumption that edge-glued joints are acceptable in all cuttings. It is assumed that cuttings of any given length will be edge glued into panels of a suitable width and subsequently ripped into the desired cutting width. Yields shown in the pairs of nomograms include the full ripped width, specified length cuttings and salvage cuttings 1 inch and wider of the specified length. Allowance for losses in ripping the specified width cuttings from the glued-up panel have been made. This allowance is adequate for ripping panels into specified widths equal to or wider than the *original gang ripped* width. In most cases cutting widths will be greater than gang rip widths resulting in final yields slightly higher than shown in the nomograms.

Two nomograms and a rip width selection table (table 1) are presented for each of the lumber grades: Firsts and Seconds (FAS), Selects (Sel), Number One Common (No. 1 C), Number Two Common (No. 2 C), and Number Three A Common (No. 3A C). The first one of the nomogram pair for each lumber grade shows in percent of total lumber surface area the yield of specified length, clear, two-face cuttings when the lumber is gang ripped into 1-inch widths. The second nomogram of each pair shows the percentage of adjustment with which to modify yield values from the primary nomogram for gang rip widths other than 1 inch. The rip width table shows the gang rip width that promises the highest yield for each cutting length for which the *nomograms are constructed.*

[1] Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

[2] National Hardwood Lumber Association (NHLA) "Rules for the Measurement and Inspection of Hardwood and Cypress Lumber."

[3] *Hiram Hallock and Pamela Giese, "Does Gang Ripping Hold the Potential for Higher Clear Cutting Yields."* (USDA For. Serv. Res. Pap. FPL 369, For. Prod. Lab., Madison, Wis., 1980.)

[4] G. Englerth and D. Schumann, "Charts for Calculating Dimension Yields from Hard Maple Lumber." (USDA For. Serv. Res. Pap. FPL 118, For. Prod. Lab., Madison, Wis., 1969.)

Use of the Nomograms to Calculate Yields and Lumber Requirements

For purposes of illustration, let us assume a relatively simple cutting bill is to be cut from No. 1 C lumber. The cutting sizes and required numbers arranged in descending order of length are:

Length (In.)		Width (In.)	Number
60	x	3.5	100
48	x	4.0	600
26	x	2.0	300
12	x	6.0	100

The longest cutting (60 inches) is known as the "primary" cutting and the other cuttings (48, 26, and 12 inches) as "subsequent" cuttings.

It is first necessary to refer to table 1 for the gang rip width which promises the highest yield for the primary (60-inch) cutting length from No. 1C lumber. Table 1 shows the 1.5-inch width to be best for all cutting lengths from 68 to 28 inches.

Use of a standardized data form similar to table 2 for recording observed and calculated values will greatly simplify the prediction computations. Consider first only that part of table 2 above the head "second calculation." Cutting sizes are entered sequentially with the longest first and the shortest last. The number of cuttings of each size is entered in the second column and total surface measure of each of the cuttings in column 3. This measure is calculated by multiplying the length and width in inches by the number of pieces and dividing by 144. For example

$$\frac{60 \times 3.5 \times 100}{144} = 145.8$$

It is useful for the crosscut operation to know the actual number of ripped strip pieces of each given length that are required to yield the required cuttings of each length and width. Usually the rip width will differ from the cutting width so the number of pieces required will also differ. To calculate the number of pieces, the number of cuttings is multiplied by a factor obtained by dividing the cutting width by the rip width. For example:

$$\frac{3.5}{1.5} \times 100 = 233.3 \text{ pieces}$$

for the 60-inch cuttings. Since an extra piece is required to yield the 0.3, the actual requirement is 234 pieces.

Reference is now made to the first of the nomogram pair for No. 1 Common lumber (fig. 3a). Begin by determining the yield for the longest cutting. Find the cutting length of 60 inches on the right-hand scale labeled "Length of Longest Cutting" and project this point horizontally to the far left scale labeled "Predicted Yield." The indicated percent is 35.7. Now the yield for the next longest cutting will be predicted. This yield is determined by finding the intersection of a line projected vertically from the 60-inch primary cutting and the 48-inch "Length of Subsequent Cutting" curve. From this point, project a horizontal line to the far left scale. The percent yield is seen to be 45.0 percent. The other two subsequent length cuttings of 26 and 12 inches are determined in the same manner as the 48-inch cutting.

These yields will be found to be 57.4 percent and 61.8 percent, respectively. All values are entered in the calculation form, table 2.

The values shown on the nomogram are for a rip width of 1 inch. Rip widths other than 1 inch require adjustment by the use of the width adjustment nomogram (fig. 3b). In this case, the rip width is 1.5 inches. Beginning with the longest cutting, locate the intersection of the 60-inch cutting length and the 1.5-inch rip width curve. Project this point horizontally to the left-hand scale labeled "Yield Adjustment" to obtain a value of +0.3 percent. Repeat this procedure for the 48-, 26-, and 12-inch cutting lengths. These yields are found to be +1.3 percent, +4.5 percent, and +7.5 percent, respectively. Enter all adjustment values in the calculation form, table 2. Adjusted yield values are now entered and are the sum for each cutting length of the basic value from the 1-inch nomogram and the width adjustment value.

The net yields for each cutting length can now be derived from the adjusted yield values. Since the values shown in the adjusted column are cumulative totals (the indicated length and all longer cuttings) the predicted yield for each length other than the longest is obtained by subtraction. Thus, the 60-inch is 36 percent, the 48-inch is 10.3 percent (46.3-36.0), the 26-inch is 15.6 percent (61.9-46.3), and the 12-inch is 7.4 percent (69.3-61.9).

The next step is to determine how

Table 1.—Best width in inches for different cutting lengths by grade

Best width	Cutting length	Best width	Cutting length
FAS		**SELECTS**	
1.5	96 - 72	1.0	96 - 94
2.0	72 - 60	1.5	94 - 36
2.5	60 - 50	5.0	36 - 10
3.0	50 - 38		
3.5	38 - 22		
4.0	22 - 10		
NO. 1 COMMON		**NO. 2 COMMON**	
1.0	80 - 68	1.0	40 - 38
1.5	68 - 28	1.5	38 - 22
2.0	28 - 26	2.0	22 - 20
2.5	26 - 24	2.5	20 - 18
3.0	24 - 22	3.0	18 - 12
3.5	22 - 18	3.5	12 - 10
4.5	18 - 10		
NO. 3A COMMON			
1.5	30 - 18		
2.0	18 - 16		
3.0	16 - 12		
3.5	12 - 10		

Table 2.—Observed and calculated values of lumber grade No. 1 Common, rip width 1.5 inches

1	2	3	4	5	6	7	8	9	10	11
Cutting data				Nomogram data				Surface measure		
Size	No.	SM	Ripped pieces	Yield	Width adjustment value	Adjusted yield	Net yield	Lumber required	Subsequent cutting	Balance
In.		Fsm		Pct.	Pct.	Pct.	Pct	Fsm	Fsm	Fsm
					FIRST CALCULATION					
60 x 3.5	100	145.8	234	35.7	+0.3	36.0	36.0	405	—	0.0
48 x 4.0	600	800.0	1,600	45.0	+1.3	46.3	10.3	—	41.7	-758.3
26 x 2.0	300	108.3	400	57.4	+4.5	61.9	15.6	—	63.2	-45.1
12 x 6.0	100	50.0	400	61.8	+7.5	69.3	7.4	—	30.0	-20.0
					SECOND CALCULATION					
48 x 4.0	—	758.3	1,517	41.6	+1.3	42.9	42.9	1,768	—	0.0
26 x 2.0	—	45.1	167	56.3	+4.5	60.8	17.9	X	316.5	+271.4
12 x 6.0	—	20.0	160	61.5	+7.5	69.0	8.2	X	145.0	+125.0

much lumber (No. 1 Common in this case) is required to produce the necessary ripped pieces for the longest cutting length. The 36 percent estimated yield is the same as 360 feet surface measure of cuttings from 1000 feet surface measure of lumber. The required surface measure of 60-inch cuttings is 145.8 (column 3, table 2). When this figure is divided by 360 and multiplied by 1,000, 405 feet surface measure of lumber are found to be required to yield the 60-inch cuttings.

Yields for the other cutting lengths that will be developed in cutting 405 feet surface measure No. 1 Common lumber are next determined. Applying the percent values shown in column 8 to 1,000 feet surface measure indicates recoveries of 103, 156, and 74 feet surface measure for 48, 26, and 12-inch cutting lengths. Since only 405 feet surface measure are being cut, the predicted yields are found by dividing 405 by 1,000 and multiplying by the expected yield for 1,000 feet surface measure. Thus, the yield for 48 inches is 0.405 x 103 or 41.7 feet surface measure. The yields for all subsequent lengths are calculated and entered in column 10 of table 2. A summary of the cuttings still to be obtained is shown in column 11. All pieces required for the 60-inch length have been obtained so the balance is "0." The balance for the other lengths is obtained by subtracting column 10 from column 3.

At this point the requirement for 60-inch cuttings has been met, and the requirements for the other subsequent cuttings have been met partially. A second calculation for the unfilled cutting requirements is initiated. It is nearly identical to the first calculation chart with respect to the determination of the values to be entered. Now the 48-inch cutting becomes the longest cutting and is used as the primary cutting length on the nomogram (fig. 3a). A new determination of the best rip width for the 48-inch length is made from table 1, and, again, 1.5 inches is the best. No entries are needed in column 2. The figures in column 3 are the same as in column 11 in the first calculation chart. Figures in column 4 are determined by dividing the surface measure required from column 3 by the surface measure in one ripped piece. For example, with the 48-inch length the surface measure in one piece is 48 x 1.5 inches divided by 144, or 0.5. The required 758.3 feet surface measure divided by 0.5 equals 1,517 pieces, 48 x 1.5 inches, required. The values in column 5 are found from the nomogram (fig. 3a) using 48 inches as the primary cutting length in exactly the same manner as 60 inches was used in the first calculation.

Column 8 indicates an expected yield of 48-inch cuttings of 42.9 percent or 429 feet surface measure per 1,000 feet lumber surface measure. Since 758.3 feet surface measure are required, it is necessary to rip 1,768 feet surface measure

$$\frac{758.3}{429} \times 1,000 = 1,768 .$$

Using 1,768 feet surface measure as the new base, yields of 316.5 and 145.0 feet surface measure for 26-inch and 12-inch cuttings are available. Comparing these expected yields with the requirements in column 3 indicates they are more than met. In actual practice the crosscut saw operator would begin to develop cuttings for another cutting bill when he had 167 26-inch and 160 12-inch cuttings.

At this point all cutting requirements have been met. It is entirely possible with a longer and more complex cutting bill that more than the two calculation charts used in this example would be needed to fill all requirements. It is important to remember that, for each calculation chart, the longest remaining cutting becomes the primary cutting and that a best rip width for its length should be selected from table 1.

In this example a total of 2,173 feet (405 + 1,768) surface measure of No. 1 Common lumber would be required. However, 396.4 feet surface measure of cuttings (column 11, second calculation table 271.4 + 125.0 = 396.4) would be either unused or used to develop short cuttings for another cutting bill.

Selection of Lumber Grades

No simple method[5] exists to determine the lowest cost mix of lumber grades that will cut a specific cutting bill. It is possible to approximate the answer by making several determinations of lumber requirements using

[5] The determination of the least cost mix is possible by the linear programming technique.

different grades and pricing the lumber cost. Dividing the cutting bill into length categories and cutting each category from a different grade usually will result in lower overall cost for lumber. Length breaking points will change with lumber grade price structure but as of October 1979 are approximately as follows:

Length (in.)	Best Grade
70 + longer	FAS and Sel.
40 - 70	No. 1 Common
10 - 40	No. 2 Common

Figures 1a-5b are pairs of nomograms by which predictions can be made of the furniture clear cutting yields from standard NHLA lumber grades when the lumber is processed by gang ripping first.

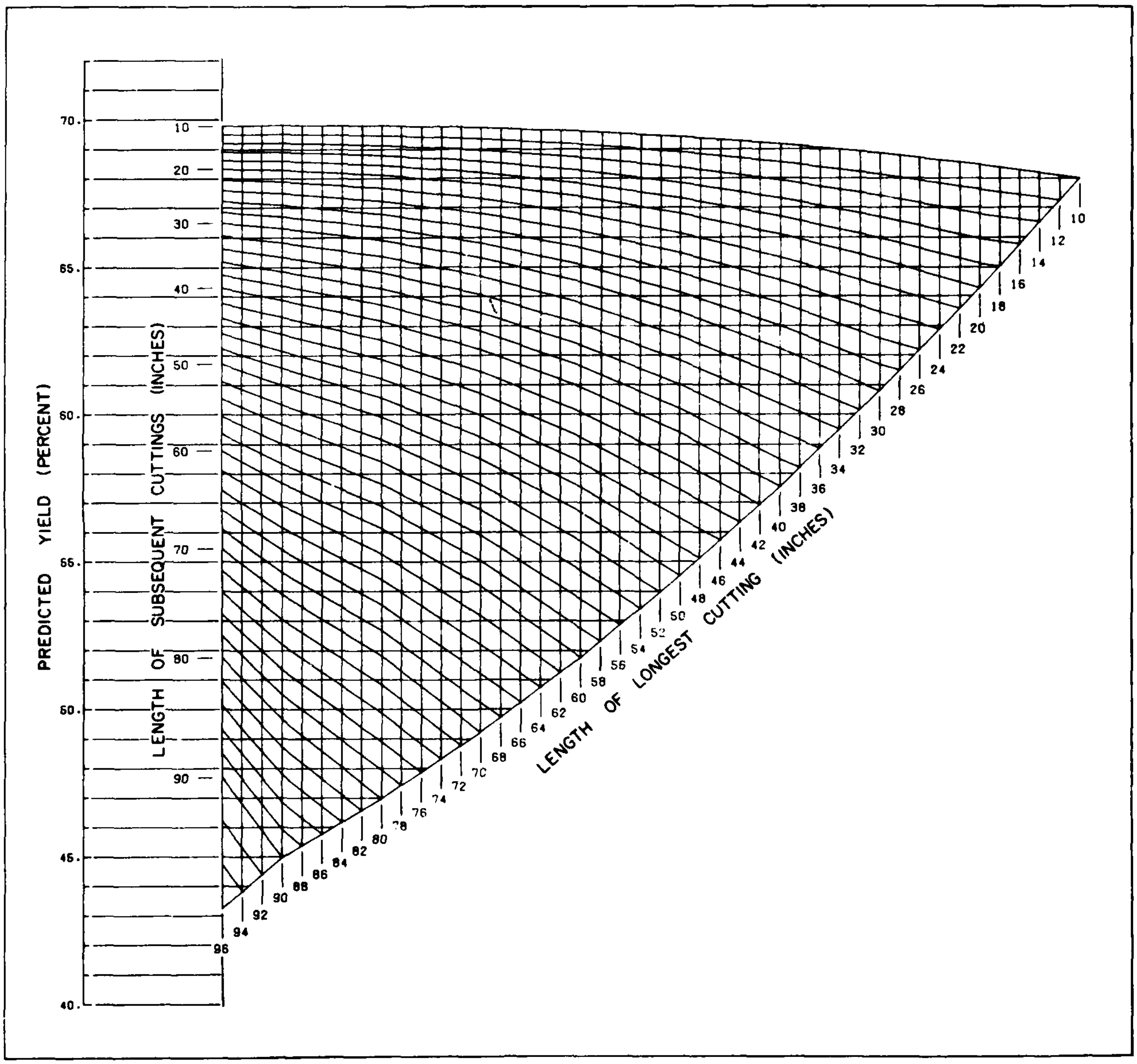

Figure 1a. FAS—Predicted yield of 1-inch wide cuttings when lumber is processed by gang ripping first.

M148 576

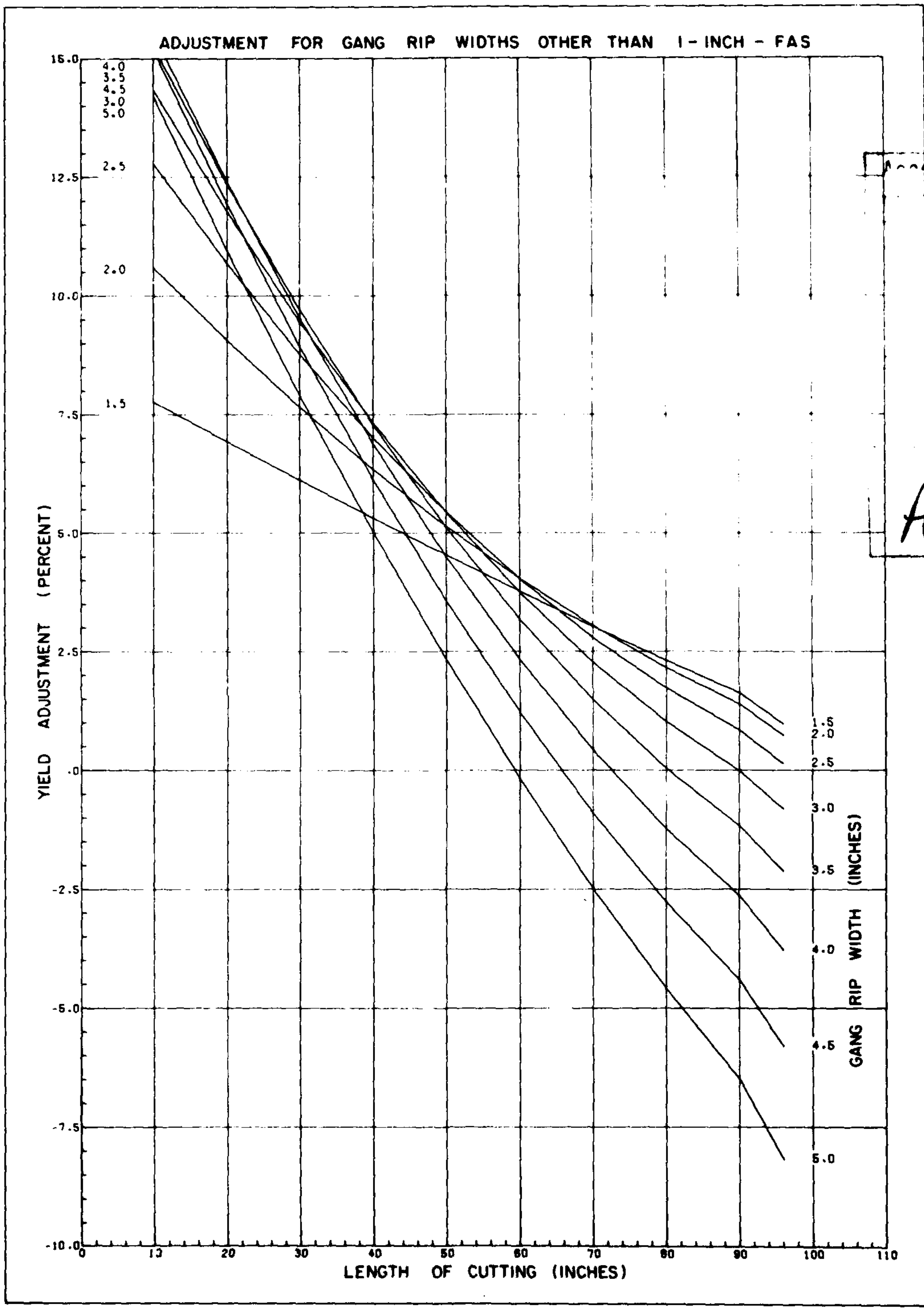

Figure 1b. FAS—Yield adjustment for gang rip widths other than 1-inch.

M148 577

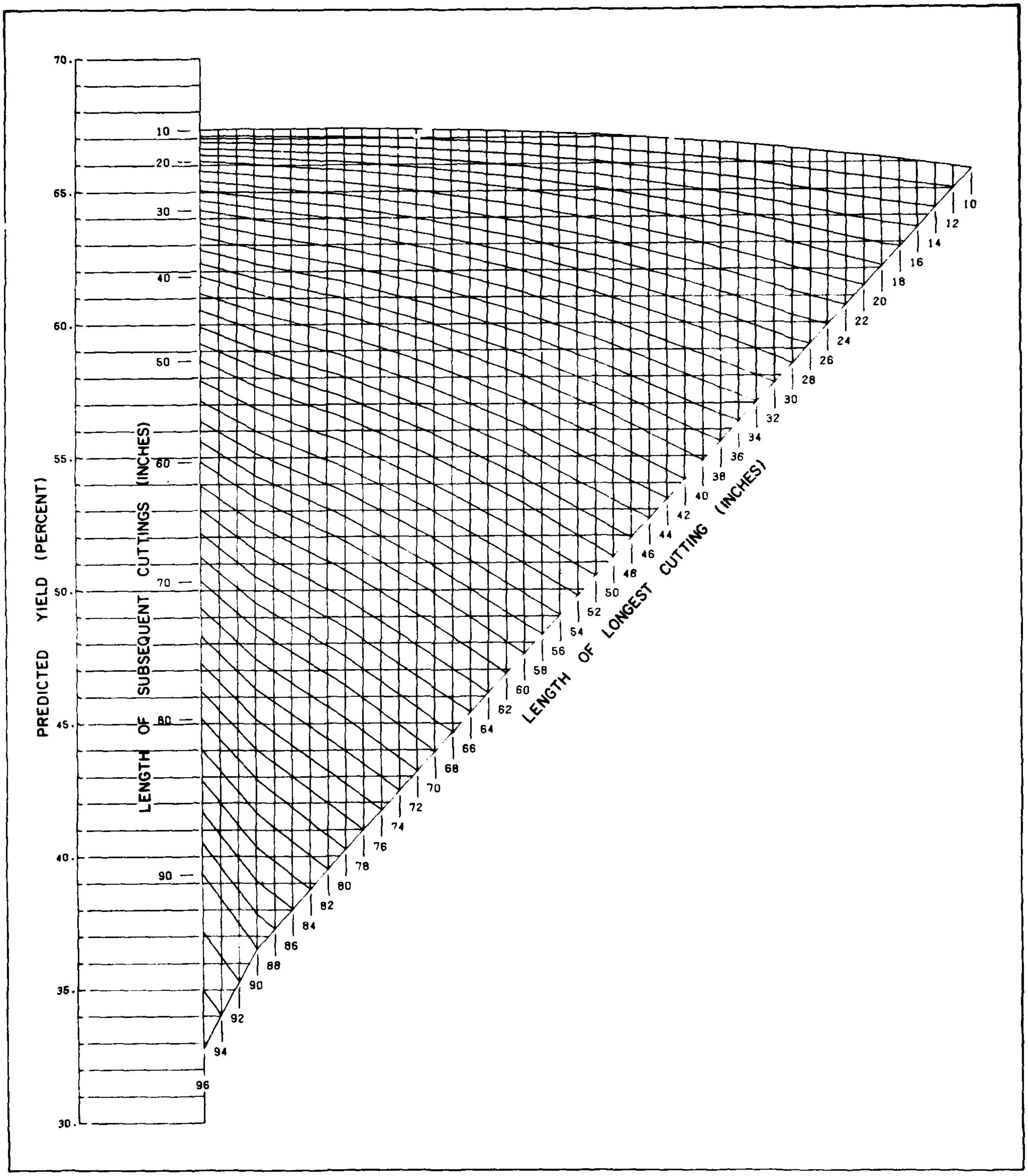

Figure 2a. Selects—Predicted yield of 1-inch wide cuttings when lumber is processed by gang ripping first.

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U.S. Forest Products Laboratory.

Cutting yields from standard hardwood lumber grades when gang ripping, by Hiram Hallock, Madison, Wis., For. Prod. Lab., 1980. 13 p. (USDA For. Serv. Res. Pap. FPL 370)

Gives complete instructions and examples for use of nomograms to predict furniture clear cutting yields from standard NHLA lumber grades when the lumber is processed by gang ripping first. Nomograms included. Users should be familiar with Res. Pap. FPL 369.

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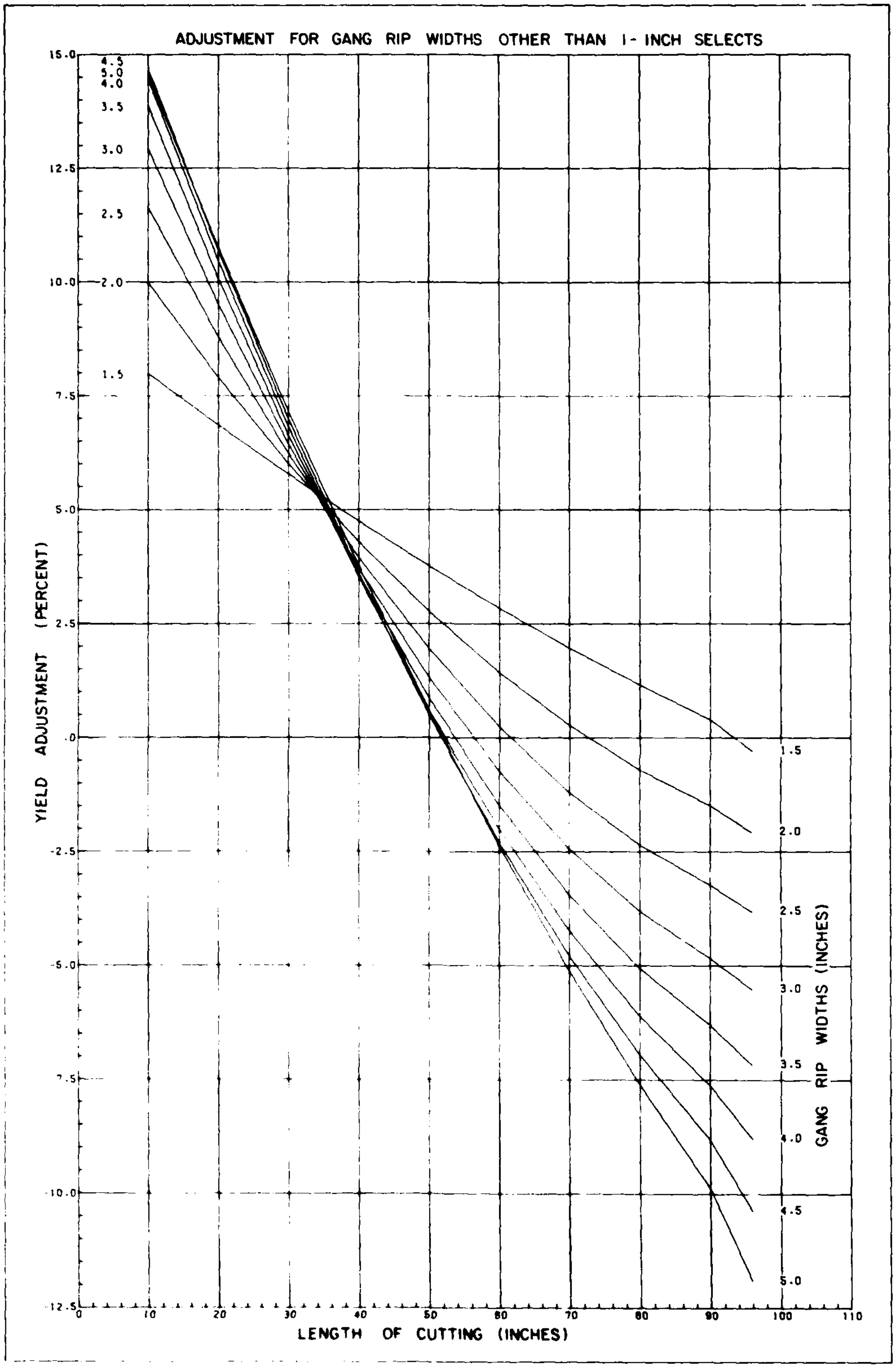

Figure 2b. Selects—Yield adjustment for gang rip widths other than 1-inch.

M148 579

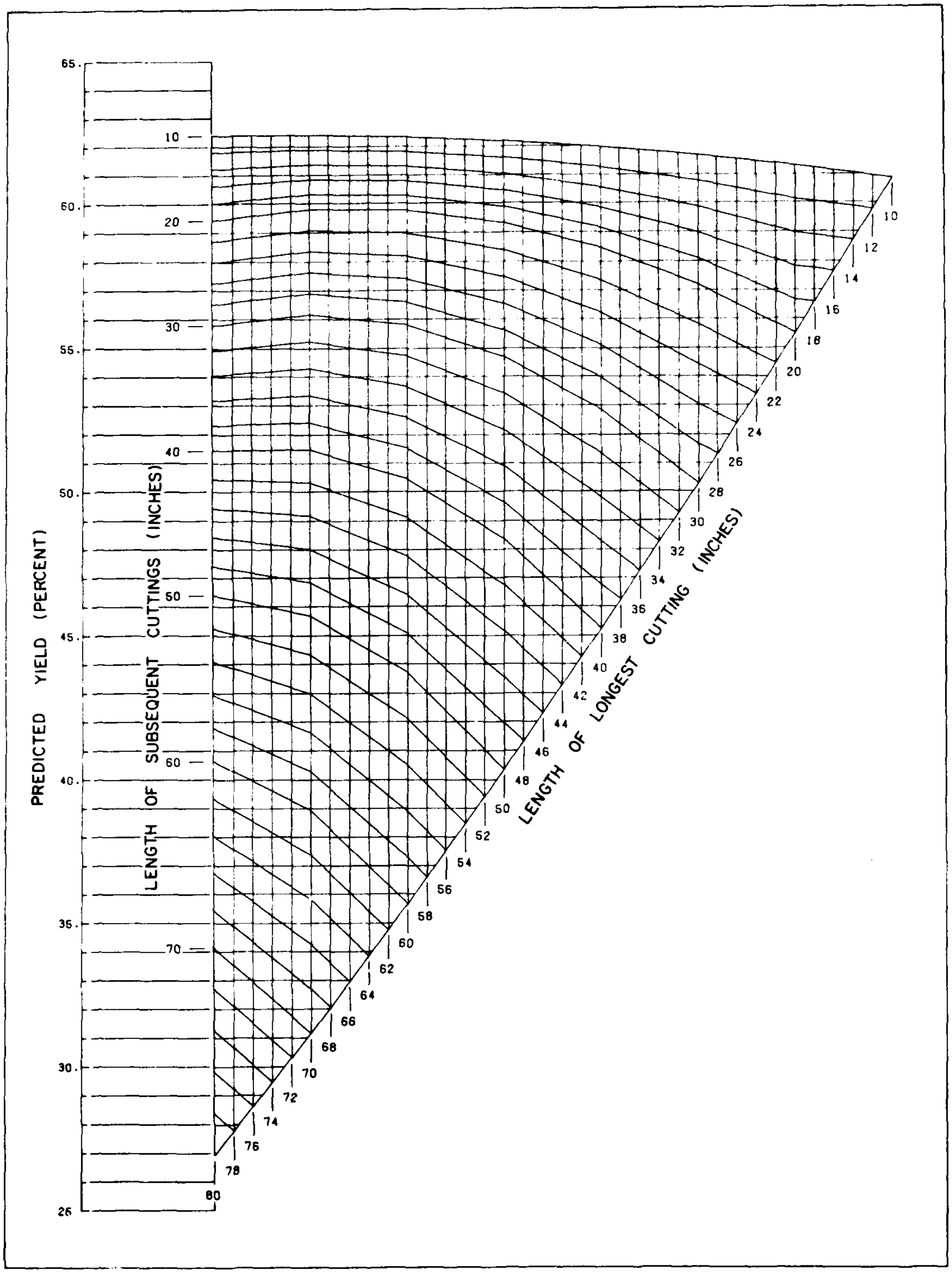

Figure 3a. No. 1 Common—Predicted yield of 1-inch wide cuttings when lumber is processed by gang ripping first.

M148 560

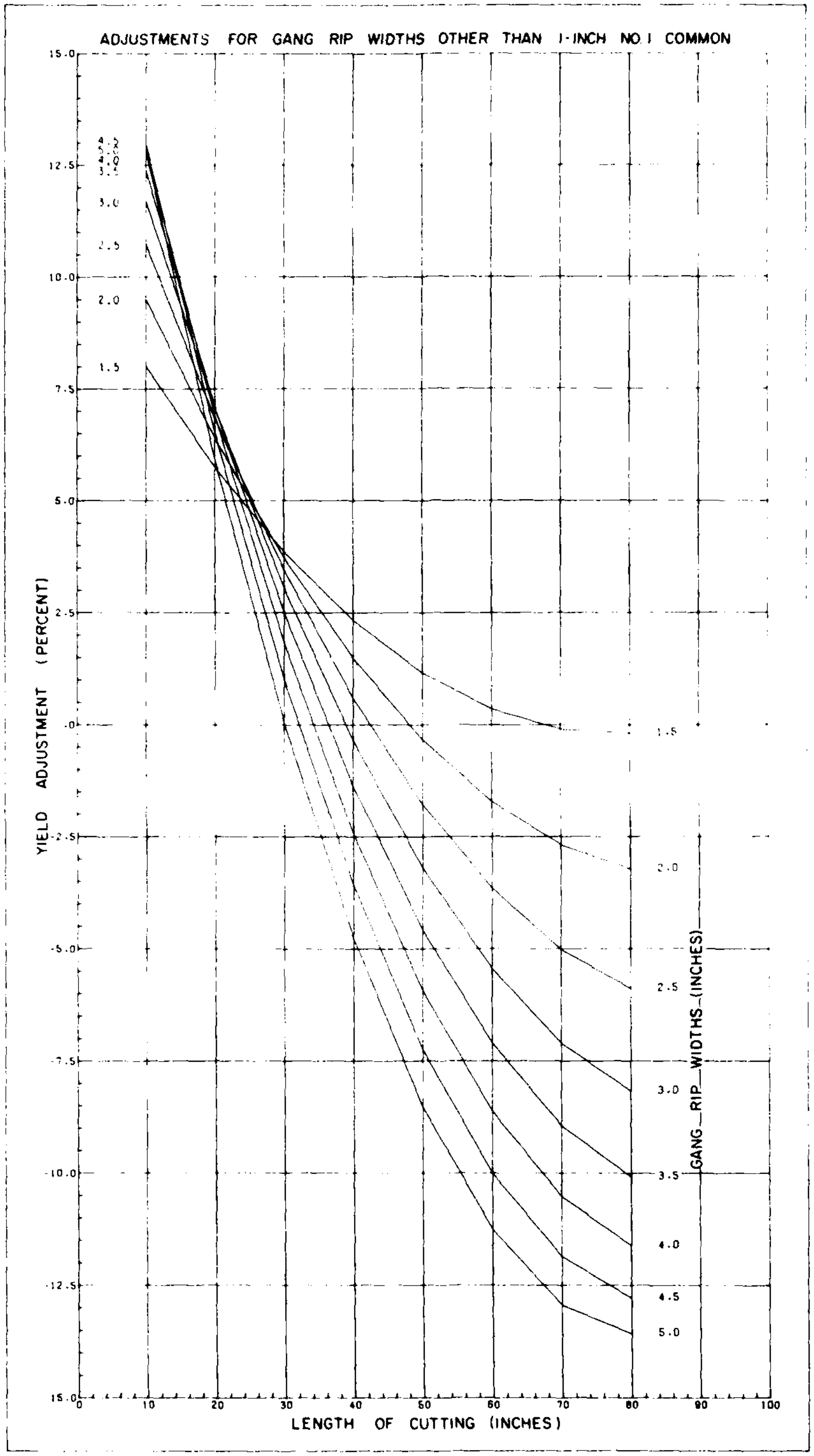

Figure 3b. No. 1 Common—Yield adjustment for gang rip widths other than 1-inch.

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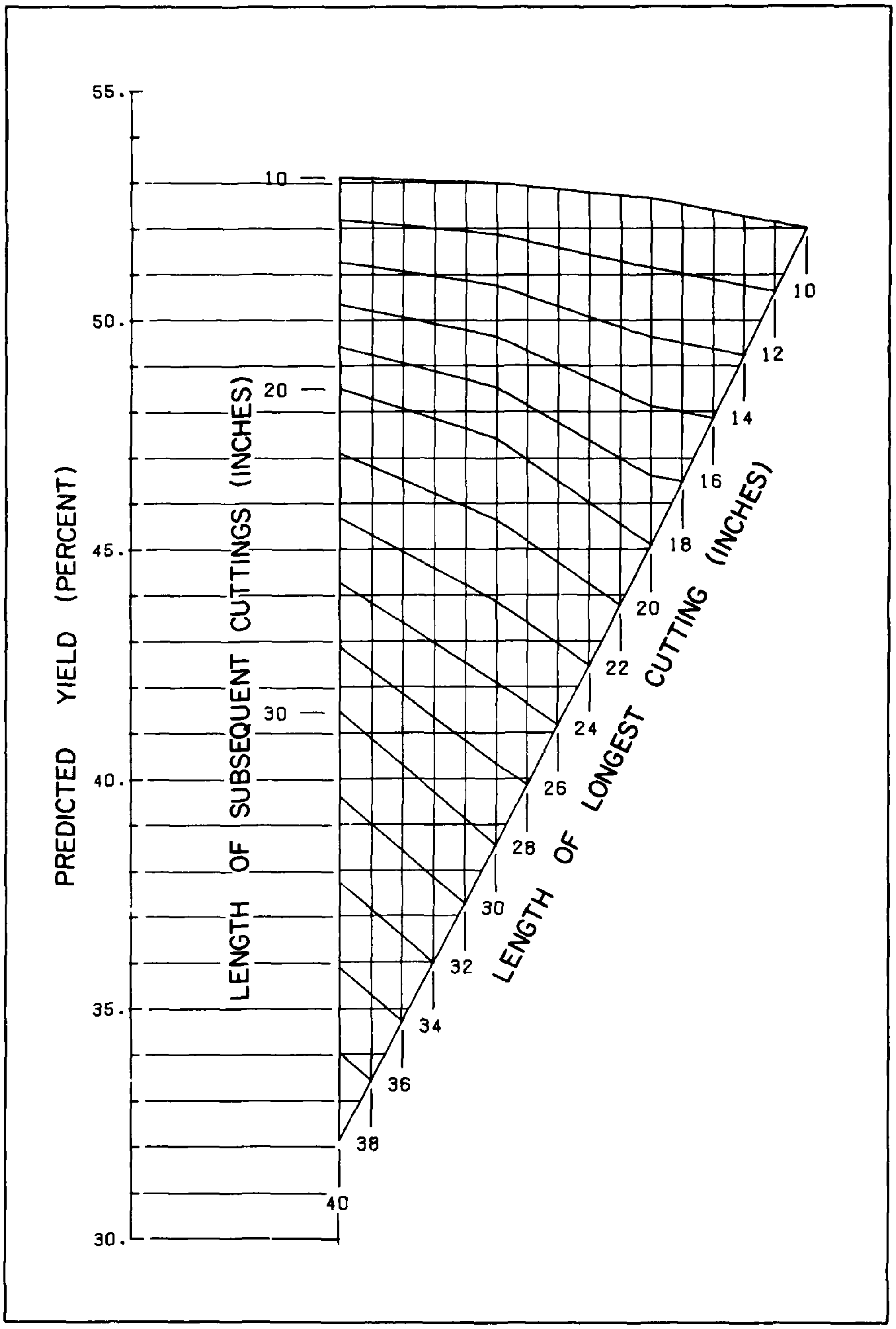

Figure 4a. No. 2 Common—Predicted yield of 1-inch wide cuttings when lumber is processed by gang ripping first.

M148 572

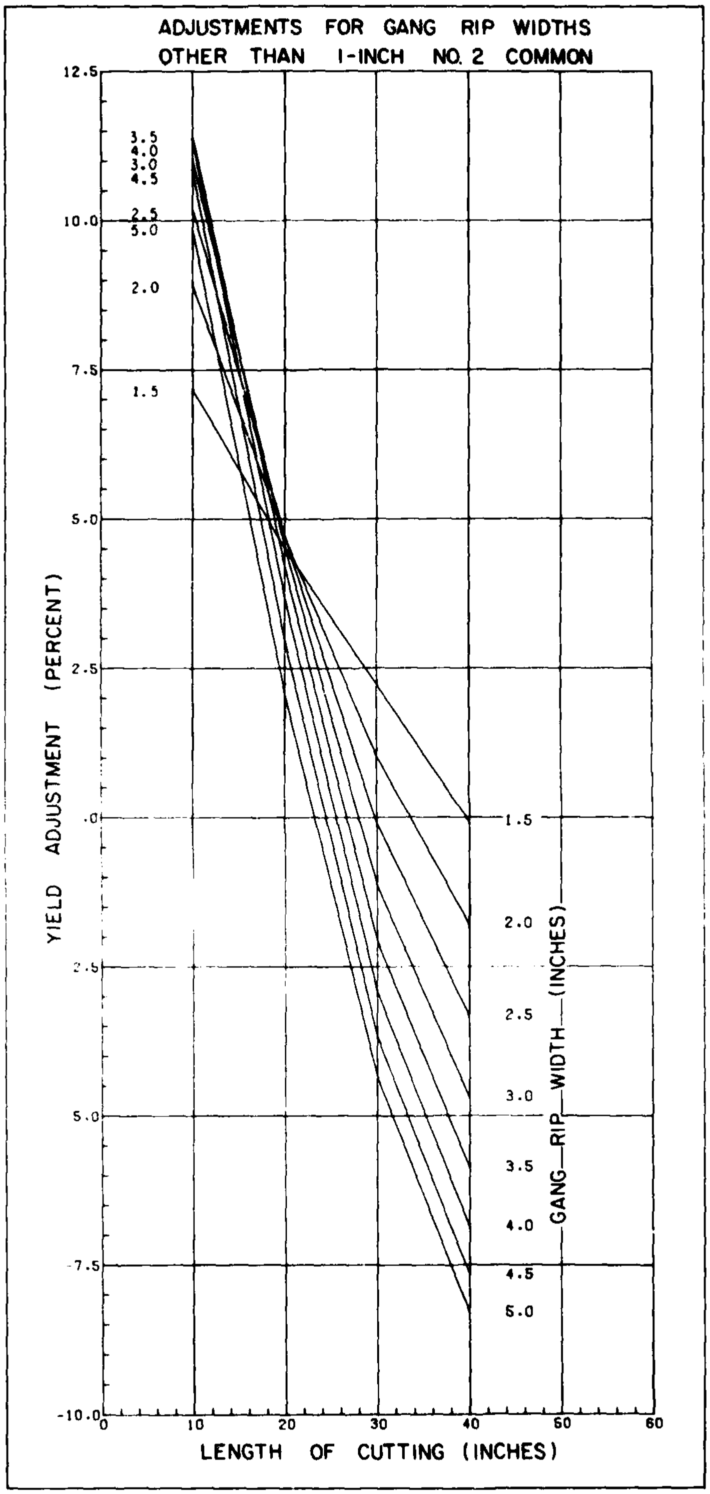

Figure 4b. No. 2 Common—Yield adjustment for gang rip widths other than 1-inch.

M148 573

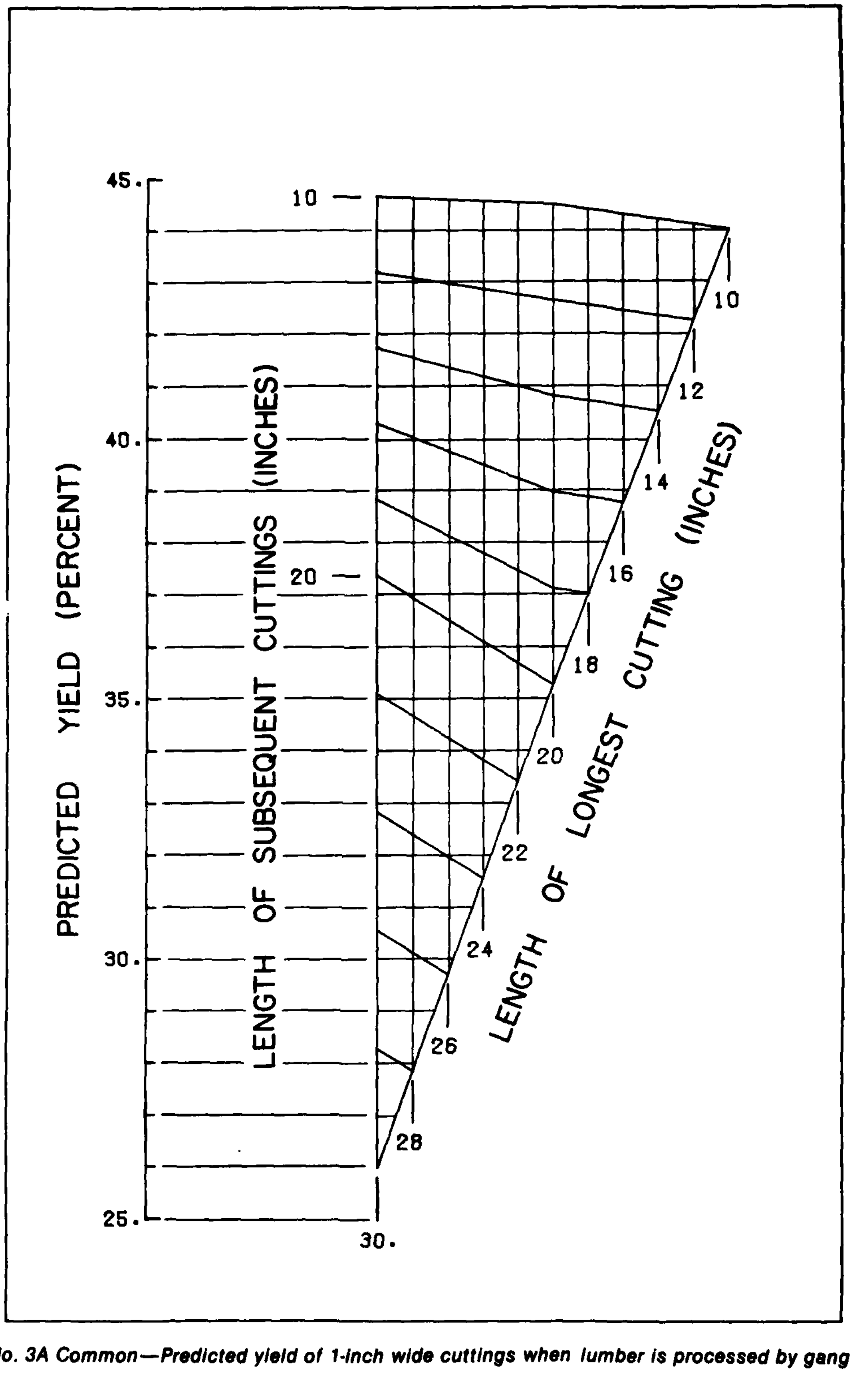

Figure 5a. No. 3A Common—Predicted yield of 1-inch wide cuttings when lumber is processed by gang ripping first.

M148 574

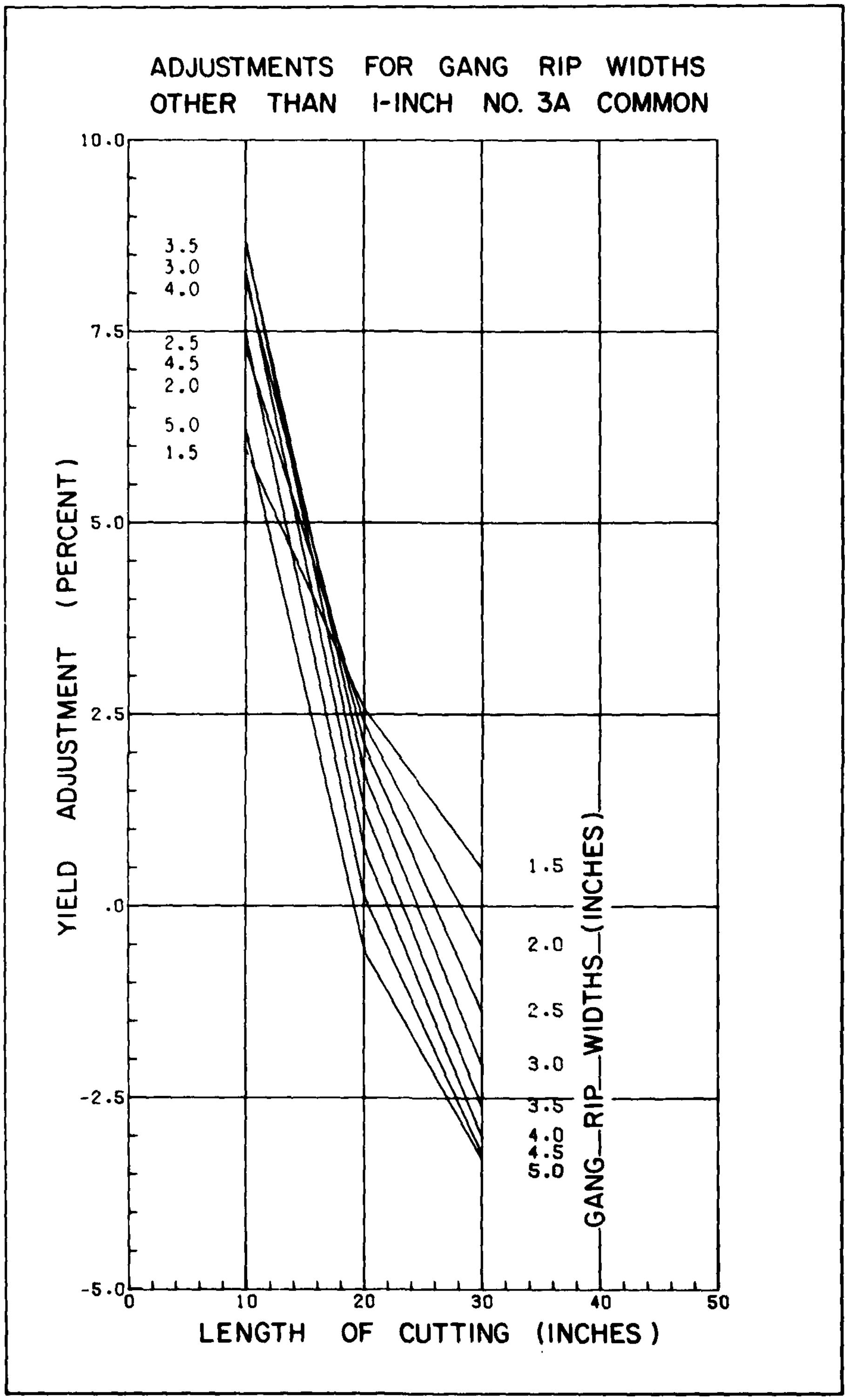

Figure 5b. No. 3A Common—Yield adjustment for gang rip widths other than 1-inch.

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